

Mindfulness

& testing number fact retrieval

Introduction

While there is an increasing amount of literature relating to the benefits of incorporating mindfulness into educational settings, much of this is associated with its role in promoting well-being, confidence and reducing anxiety, stress and fatigue in both teachers and learners in schools (i.e. Flook *et al.*, 2010; Mendelson *et al.*, 2010; Ricard *et al.*, 2013; Black and Fernando, 2014; Wisner, 2014; Call *et al.*, 2014). Some authors have alluded to the potential of mindfulness-based practice in working memory, attention and academic skills (Napoli *et al.*, 2005; Lillard, 2011; Sibinga *et al.*, 2013) but there is relatively little emphasis on measurable outcomes of mindfulness techniques on the cognitive processes associated with learning and understanding (Felver *et al.* 2015).

Although it has its roots in early Buddhist teaching, virtually all mindfulness techniques are secular. Techniques vary. Meditation, Yoga and Tai chi are relaxation techniques that are often promoted and there are a variety of activities; both teacher- and child-led; that are advocated by a number of sources (for examples, visit <http://www.mindfulschools.org> and <http://mindfulnessinschools.org>). Links can be made to practices and outcomes associated with 'character' - and meta-cognitive approaches and links with recent work in neuroscience (Roediger and Karpicke, 2006; Roediger and Karpicke, 2006; Karpicke and Roediger, 2007; McDaniel *et al.*, 2007; Boaler, 2013; Karpicke *et al.*, 2014).

The purpose of this paper is to report the effect of mindfulness practice on the recall of multiplication facts, either by rote or identifying number relationships, through a small pilot study.

Methodology

The initial parts of the pilot involved discussing with a small cohort (*n*.15) of Year 4, 5 and 6 students, the nature and role of meditation in well-being from a scientific standpoint with reference to associated relaxation techniques. Children were selected based on their ability with number and previous performance in multiplication tests in order to utilise a broad range of experiences and perceived attainment levels. Five children were chosen from each year group; a higher, middle and lower attainer, a child who has demonstrated a degree of anxiety when learning number skills and a middle attainer from each year group to act as a control. Note was made of the approach that the learner had chosen, or been suggested to follow, in the learning of multiplication facts. All children undertook a randomised, mixed multiplication test using Activeexpression in the morning and afternoon. Apart from the control group, the children undertook 15 minutes of mindfulness practice before the afternoon test. The mindfulness techniques employed involved 10 minutes of meditation/ breathing awareness followed by a short, focussed activity

Multiplication tests lasted 3 minutes and took place in the morning and afternoon over a three week period. Activeexpression was used, allowing 60 multiplication facts to be randomised, avoiding commutativity. The raw score for each child was recorded in order to track changes in recall over time and assess the effect of mindfulness techniques. The raw scores for both anxious and non-anxious children who took part in mindfulness activities were compared to previous scores in order to quantify discrete improvements, before being normalised against the results of the control group. This allowed any differences between the intervention groups to be highlighted.

Discussion

The results of the programme are represented in figures 1, 2 and 3. Figure 1 shows the results gained by all students throughout the study, while figure 2 shows the results of the two intervention groups after weighting by the 'control' group. Figure 3 shows the rate of development/ change in fluency over time. Table 1 shows correlation coefficients, as a measure of any similarities in the pattern of development in different children. These results raise a number of pertinent points:

Simple testing, with no additional support, assisted the speed of recall of multiplication facts in all groups during the pilot study

While the control group's progress involved variations at a number of scales, the other groups produced scores that were characterised by fluctuations that reflect performance before and after mindfulness intervention, with students gaining consistently higher results in the latter.

The rate of progress was accelerated in both intervention groups, with the 'anxious' group making the most progress.

As well as the apparent gap between the 'anxious' and 'non-anxious' group becoming closed over time, the pattern of development exhibited by the 'anxious' group also started to mirror that of the 'non-anxious' group in the latter parts of the pilot study.

The efficacy of testing in rote learning has been the subject of recent research. The suggestion that performance improves through testing- as well as 'learning'- has been demonstrated by McDaniel *et al.* (2007), Karpicke *et al.* (2007) and Karpicke *et al.* (2014). Work in neuroscience suggests that testing has a lot of value when it comes to rote learning- particularly as the brain's plasticity, and therefore it's cognitive ability, increases when a learner makes mistakes. This would explain why, with no coverage of multiplication in class over the study period, all students showed improvement.

The most surprising elements of the results concern the apparent impact of mindfulness techniques. Testing following mindfulness techniques resulted in higher scores, with the average improvement for each test varying between 1 and 3 points. As well as these discrete improvements, those children that had undertaken the intervention showed a quicker rate of improvement. This accelerated rate of improvement was most marked in the 'anxious' group. In addition, the pattern and rate of development in anxious children started to mirror the pattern of the 'non-anxious' group in the latter part of the study- suggesting that, as well as apparently increasing the ability of a child to recall number facts, there was a concomitant decrease in anxiety.

So how do these results relate to other findings regarding the influence of mindfulness techniques on academic attainment and learning?

Decreased anxiety levels have been reported from a number of studies and, from an academic standpoint, by Beauchemin *et al.* (2008) and Liehr and Diaz (2010). When a learner is under stress, it often has a detrimental effect on learning. The accelerated progress of the anxious group underlines the effect of stress on fluency and how mindfulness techniques may help students to overcome these hurdles. The accelerated improvement in the 'non-anxious' group, and the marked difference between pre- and post-practice scores, may also be explained by a decrease in stress levels, or it may reflect an influence on cognitive ability; such as increased behavioural regulation and executive function- the ability to employ reasoning, solve problems and remain focussed during testing. Obviously, more studies are required on this. Firstly, similar experiments need to include a larger data-set in order to assess statistical significance.

It would also be interesting to examine the efficacy of mindfulness practice in different settings, such as: groups with special educational needs and/or disabilities; different socio-economic settings and learners of different ages.

The interventions are scalable and if subsequent experiments are as fruitful as this pilot study, practice can be integrated into the 'normal' class timetable, or as a targeted intervention for specific groups. The resources necessary are very limited and, while some training may be required, the financial implications of the intervention are negligible.

The coalition government placed a great emphasis on promoting resilience and persistence through 'character education', suggesting that schools should make it part of their 'core business' to nurture pupils' self-belief, perseverance and ability to bounce back from set-backs. Supported by the CBI, senior politicians, and the government's social mobility adviser, the Character and Resilience Manifesto is the work of the All Party Parliamentary Group (APPG) on Social Mobility, and has been produced in collaboration with the CentreForum think-tank (Patterson *et al.*, 2014). It's main focus is the need to avoid concentrating solely on academic measures of success as children move through the

education system and into the workplace, with policy recommendations suggesting that pupil premium - a grant paid to schools in England to help disadvantaged children - to be extended into pre-school education. These ideas are promoted by the work of the Sutton Trust and the Education Endowment Foundation, who report that interventions which are based on meta-cognition and self-regulation are the most successful form of teaching and learning topic when measured in terms of cost, evidence and impact (Paterson, Tyler and Lexmond, 2014).

Where such programmes are widely interpreted as 'soft skills', there is a call, too, for extra-curricular activities to be made a formal aspect of teachers' contracts of employment and for private schools to share with state schools professional expertise and facilities that promote character and resilience. A belief in one's ability to succeed, the perseverance to stick to a task and the ability to bounce back from life's set-backs are qualities that have a major impact on life chances, both during education and, later, in the labour market.

Education Secretary Nicky Morgan (16 December 2014) introduced a new £3.5 million fund, designed to place character education on a par with academic learning for pupils across the country. Announced as a 'milestone in preparing young people more than ever before for life in modern Britain', the move will see new and existing projects encouraged to develop the virtues in pupils that are vital to fulfil their potential and realise their aspirations. The body also suggested that the standards watchdog Ofsted to build 'character and resilience' measures into its inspection framework, and for teacher training and career development programmes to 'explicitly focus' on the area, has been recognised by the Education Secretary as 'equally important' to young people as securing good grades (Birdwell, 2015).

It is also apposite to highlight that in recently published education tables, 4 of the top 5 performing countries; South Korea, Hong Kong, Japan and Singapore; are countries where Buddhism is a major religion. This link is even more marked when mathematical competence is compared, all top 5 countries; Singapore, South Korea, Hong Kong, Taiwan and Japan; contain between 22 and 93% practicing Buddhists. It is a fair assumption that these countries are likely to be au fait with mindfulness practices.

Conclusions

Mindfulness practice has a number of benefits. Whether the striking results regarding the influence of meditation on number skills are transferable is a different question that requires further study. The practice is cost effective and scalable. It is applicable to a variety of age groups and in a number of educational settings, both within the curriculum or on a voluntary or extra-curricular basis.

If it were to be adopted by schools, it is important to outline the potential issues with such a programme:

- The school's capacity to deliver the training opportunities for children to practice the techniques;
- How efficiently the impact of the techniques are measured and reported by schools and those bodies who monitor them (schools, Ofsted) and;
- How to overcome the reticence of practitioners, parents and students to employ methods that have antecedents and real or perceived links with religious beliefs and practices.

This said, resilient, happy and relaxed children can only make better learners.

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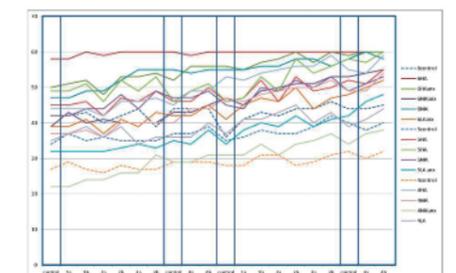


Figure 1. Raw scores of multiplication test (60 questions). HA= higher ability, MA= middle ability LA= lower ability. Control= no mindfulness intervention. Anax child exhibiting maths anxiety

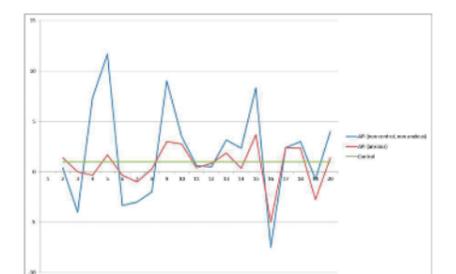


Figure 2. Variation in average points increase (API) for anxious and non-anxious intervention groups.

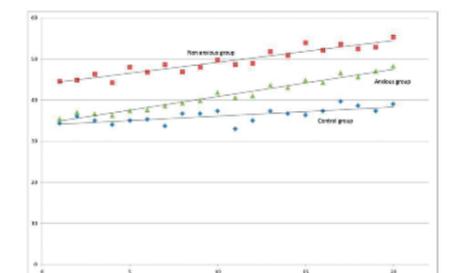


Figure 3. The rate of development/ change in fluency over time in the intervention and control groups

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